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<p>(21) International Application Number: PCT/US79/00259 (22) International Filing Date: 23 April 1979 (23.04.79) (71) Applicant (for all designated States except US): CATERPILLAR TRACTOR CO. [US/US]; 100 Northeast Adams Street, Peoria, IL 61629 (US). (72) Inventor; and (75) Inventor/Applicant (for US only): AMDALL, John, K. [US/US]; 7009 North Rockvale Drive, Peoria, IL 61614 (US). (74) Agents: BELL, James, R. et al.; 100 Northeast Adams Street, Peoria, IL 61629 (US).</p>		<p>(81) Designated States: CH (European patent), DE (European patent), FR (European patent), GB (European patent), JP, SE (European patent), US.  Published With international search report</p>
<p>(54) Title: OIL COOLED PISTON</p> <p>(57) Abstract</p> <p>Substantial heat is generated at the crown portion (18) of a piston (10). Cooling fluid has been directed to cavities (46) in the underside of the crown (18). However, at critical points of the piston cycle, the fluid drains from the cavities due to the forces of gravity. An oil cooled piston (10) is provided which includes a fluid trap (50) adjacent the crown (18). Some of the cooling fluid is trapped as it drains and is retained to enhance cooling of the crown (18). The fluid trap (50) includes a slot (60) permitting a jet spray of lubricating oil to be directed past the trap (50) to the cavities adjacent the underside of the crown (18).</p>		

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DescriptionOil Cooled PistonTechnical Field

5 This invention relates generally to expandible chamber devices and more particularly to pistons having lubricating means including chambers or pockets.

Background Art

10 In the past, lubricating oil has been sprayed upwardly into a cooling dome and an annular cooling groove adjacent the underside of the piston crown for the purpose of cooling. Also, a ledge or splash sill has been provided for trapping some of the oil and for directing the trapped oil back into the groove to supplement the oil spray.

15 A problem exists in that the ledge is positioned at the outer periphery of the piston which causes interference with the oil spray and which also causes poor directing of the trapped oil back into the groove.

20 In view of the above, it would be advantageous to provide an oil cooled piston having a ledge or splash sill which does not interfere with the spray, which better directs trapped oil back into the groove and which overcomes the problems associated with the prior art.

Disclosure of Invention

25 In one aspect of the present invention, the problems pertaining to the known prior art, as set forth above, are advantageously avoided by the present invention.

30 This is accomplished by providing an oil cooled piston including a crown having inner and outer annular walls. The walls define an annular groove



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including an annular opening. The outer wall has an end surface adjacent the opening. Means are provided for trapping fluid. Such means includes a substantially annular ledge extending from the inner wall toward the outer wall terminating at a lip. The lip is spaced from the end surface. A sloping surface on the ledge extends between the inner wall and the lip and is adjacent the annular opening.

The foregoing and other advantages will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended as a definition of the invention but are for the purpose of illustration only.

#### Brief Description of the Drawings

In the drawings:

FIGURE 1 is an enlarged cross-sectional view illustrating an embodiment of the present invention;

FIGURE 2 is a bottom plan view taken along the line II-II of Figure 1;

FIGURE 3 is another enlarged cross-sectional view illustrating an embodiment of the present invention;

FIGURE 4 is a view taken along the line IV-IV of Figure 3;

FIGURE 5 is an enlarged partial cross-sectional view illustrating the preferred embodiment of this invention;

FIGURES 6-8 are enlarged partial cross-sectional views illustrating alternative embodiments of this invention; and

FIGURES 9,10 are enlarged partial cross-sectional views illustrating a cooling oil spray during the piston stroke.



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Best Mode for Carrying Out the Invention

A piston is generally designated 10, Fig. 1, for reciprocating motion due to pin 12 and connecting rod 14 attached to piston boss 15 at one end 17 and to a crankshaft (not shown) at an opposite end in the well known manner. Also, a conventional cylinder liner 16 is provided for guiding the reciprocating action of piston 10.

Piston 10 includes an upper crown portion 18 and a lower skirt portion 20. In this example, the lower skirt portion 20 is well known and includes partial skirts 20a, 20b.

Crown portion 18 includes inner and outer wall portions 22, 24, respectively, defining an annular groove 26 closed at an upper end 28 and having an opening at a lower end 30. Outer wall 24 includes conventional grooves 32 carrying compression rings 34. An annular relief 36 is provided between rings 34 and a relief 38 is provided below rings 34 for carrying oil control ring 40.

Outer wall 24 terminates at end surface 42 just below oil control ring 40. Skirt portion 20 is just below end surface 42 and spaced therefrom by an opening 44.

Inner wall 22 separates groove 26 from crown 18 and cooling dome 46. Wall 22 extends downwardly past opening 44 to pin boss 15.

Piston 10 is preferably cast from iron to form a thin-walled, light-weight, one-piece unit. However, upper dome portion 18 could be cast separately from lower skirt portion 20 and the portions could then be welded together at 19 by a brazing process if desired.



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A conventional piston cooling jet 48 is fixedly positioned adjacent lower skirt 20 for spraying a jet of fluid such as lubricating oil upwardly into annular groove 26 and cooling dome 46 as is known.

5 The jet, Figures 9, 10, constantly sprays the oil upwardly to the underside of the crown 18. The spray is directed so that when the piston is bottom dead center or when the reciprocating piston 10 is at its lowermost position relative to the fixed jet 48, the  
10 spray bathes and cools groove 26 which has become heated due to proximity to crown 18. When the piston 10 is at top dead center, the spray bathes and cools dome 46. This momentary cooling is advantageous but does not continuously cool both the groove 26 and the  
15 dome 46.

To enhance cooling, well known splash sills have been used to trap the oil as it drains downwardly and thereafter cause a secondary splash of trapped oil from the sill into the groove 26 as the piston 10 begins  
20 its downward stroke. An improved splash sill 50, Figs. 5-8, is provided as a means for trapping oil. Sill 50 is formed as a substantially annular ledge extending radially outwardly from inner wall 22 adjacent opening 44 and reaching toward outer wall 24. Ledge or sill  
25 50 also extends axially upwardly toward crown 18. Ledge 50 terminates at lip portion 52 which is spaced from end surface 42. The preferred configuration for ledge 50 is illustrated in Fig. 5.

A sloping upper surface 56 is provided on  
30 ledge 50. Surface 56 may be of a substantially constant slope such as that shown in Figs. 5-7 or may be curved or cup-shaped such as is shown in Fig. 8. Surface 56 provides ledge 50 with angular disposition relative to inner wall 22. Thus, ledge 50 and wall 22 cooperate to form a trough-like fluid trap.

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In order to provide the maximum cooling splash for bathing groove 26, it has been discovered according to this invention, that ledge 50 is most advantageously situated as described above, that is, extending outwardly from inner wall 22 and sloped upwardly toward crown 18. However, situated as such, ledge 50 is directly in the oil jet spray path extending between jet 48 and groove 26. Advantageously, ledge 50 includes a slot 60 as a means for permitting the pressurized stream to be directed past ledge 50 and into groove 26, see Figs. 2 and 4. As illustrated, slot 60 is formed in duplicate (two slots 60, 180 degrees diametrically opposed) for the purpose of providing a piston which can be installed without concern as to the location of slot 60. However, since only one jet 48 is usually provided, only one slot 60 is required.

#### Industrial Applicability

Piston 10 reciprocates downwardly to bottom dead center and jet 48 directs lubricating oil upwardly past ledge 50 via slot 60 into groove 26. The oil bathes and momentarily cools groove 26, thereafter drains downwardly and is trapped by ledge 50 as piston 10 accelerates upwardly to its top dead center position where the oil then bathes the dome 46. As piston 10 begins to reverse direction at the top dead center position and reciprocates downward again, oil trapped between surface 56 and inner wall 22 tends to continue upwardly and is thus splashed into groove 26 thus supplementing the direct cooling from the jet spray which thereafter occurs when piston 10 once again reaches bottom dead center.



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The foregoing has described an oil cooled piston having a ledge or splash sill which does not interfere with the spray of oil into the cooling groove and which better directs trapped oil back into the groove to supplement the spray.

Other aspects, objects and advantages of this invention can be obtained from a study of the drawings, the disclosure and the appended claims.





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CLAIMS

1. An oil cooled piston (10) comprising:  
a crown portion (18);  
inner (22) and outer (24) annular walls  
connected to said crown portion (18) defining an  
5 annular groove (26) including an annular opening  
(30), said outer wall (24) having an end surface (42)  
adjacent said opening (30); and  
means for trapping fluid, said means being a  
substantially annular ledge (50) extending from said  
10 inner wall (22) toward said outer wall (24) terminating  
at a lip (52) spaced from said end surface (42) and  
having a sloping surface (56) between said inner wall  
(22) and said lip (52), said sloping surface (56)  
being adjacent said annular opening (30).
- 15 2. The piston of claim 1 including:  
a slot (60) extending through said fluid  
trapping means (50).
3. In an oil cooled piston (10) having inner  
(22) and outer (24) annular walls connected to a crown  
20 portion (18), said walls defining an annular cooling  
groove (26) including an annular opening (30), said  
outer wall (24) having an end surface (42) adjacent  
said opening (30), the improvement comprising:  
means for trapping fluid and for directing  
25 trapped fluid into said annular groove (26) in re-  
sponse to reciprocating motion of said piston, said  
means being a substantially annular ledge (50) extend-  
ing from said inner wall (22) toward said outer wall  
(24) terminating at a lip (52) spaced from said end  
30 surface (42) and having a sloping surface (56) ex-  
tending from said inner wall (22) to said lip (52),  
said sloping surface (56) being angularly disposed  
with the inner wall (22).



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4. An oil cooled piston (10) comprising:  
a crown portion (18);  
inner (22) and outer (24) annular walls connected to said crown portion (18) defining an annular  
5 groove (26) including an annular opening (30), said  
outer wall (24) having an end surface (42) adjacent  
said opening (30);

means for trapping fluid and for directing  
trapped fluid into said annular groove (26) in response  
10 to reciprocating motion of said piston, said means  
being a substantially annular ledge (50) extending  
from said inner wall (22) toward said outer wall (24)  
terminating at a lip (52) spaced from said end surface (42) and having a sloping surface (56) extending  
15 from said inner wall (22) to said lip (52), said  
sloping surface (56) being angularly disposed with the  
inner wall (22);

means (60) for permitting a pressurized stream  
of fluid to be directed past said ledge (50) to said  
20 annular groove (26).

5. The piston of claim 4 wherein the means  
for permitting said fluid to be directed past said  
ledge (50) comprises at least one slot (60) formed in  
said ledge (50).

25 6. The piston of claim 4 wherein said sloping  
surface (56) has a substantially constant slope.

7. In an oil cooled piston (10) operating in  
combination with a pressurized stream of cooling fluid  
directed toward a crown portion (18) of said piston (10),  
30 and inner (22) and outer (24) walls connected to said  
crown portion (18), said walls (22,24) defining an  
annular cooling groove (26) including an annular opening (30), said outer wall (24) having an end surface (42) adjacent said opening (30), the improvement comprising:



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Claim 7 (continued)

means for trapping said fluid and for directing said trapped fluid into said annular groove (26) in response to reciprocating motion of said piston, said means being a substantially annular ledge (50) extending from said inner wall (22) toward said outer wall (24) terminating at a lip (52) spaced from said end surface (42) and having a sloping surface (56) extending from said inner wall (22) to said lip (52), said sloping surface (56) being angularly disposed with said inner wall (22); and

means (60) for permitting said pressurized stream to be directed past said ledge (50).

8. The piston of claim 7 wherein said means for permitting said pressurized stream comprises an opening (60) formed in said ledge (50).

9. An oil cooled piston (10) comprising:  
a crown portion (18);  
inner (22) and outer (24) annular walls connected to said crown (18) portion defining an annular groove (26) including an annular opening (30), said outer wall (24) having an end surface (42) adjacent said opening (30);

means for trapping fluid, said means being a substantially annular ledge (50) extending from said inner wall (22) toward said outer wall (24) terminating at a lip (52) spaced from said end surface (42) and having a surface (56) between said inner wall (22) and said lip (52), said surface (56) extending toward said crown (18) and being adjacent said annular opening (30); and

means (60) for permitting a pressurized stream of fluid to be directed past said ledge (50) to said annular groove (26).



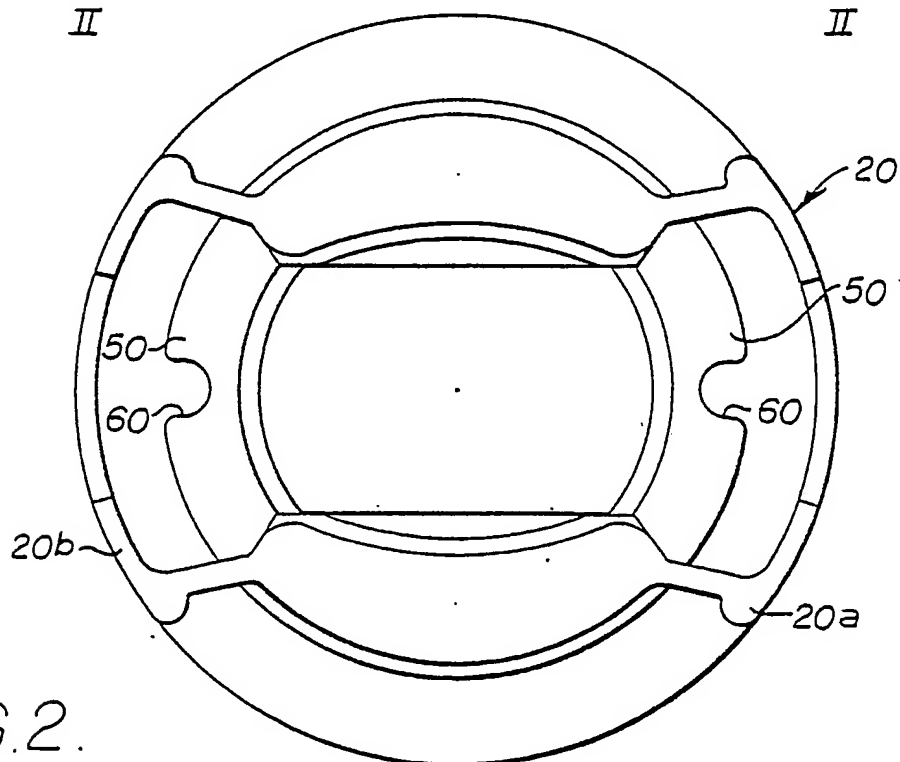
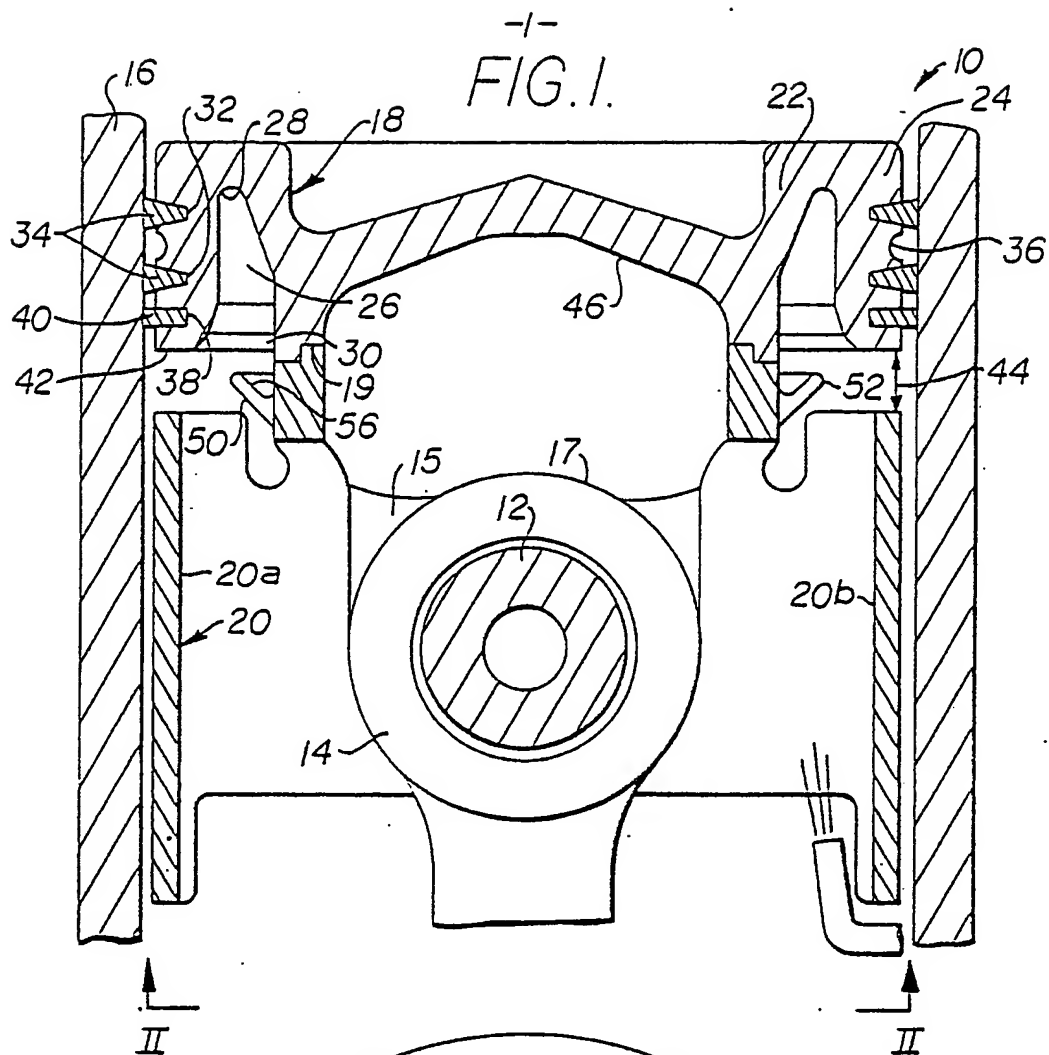


FIG. 2.

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FIG. 3.

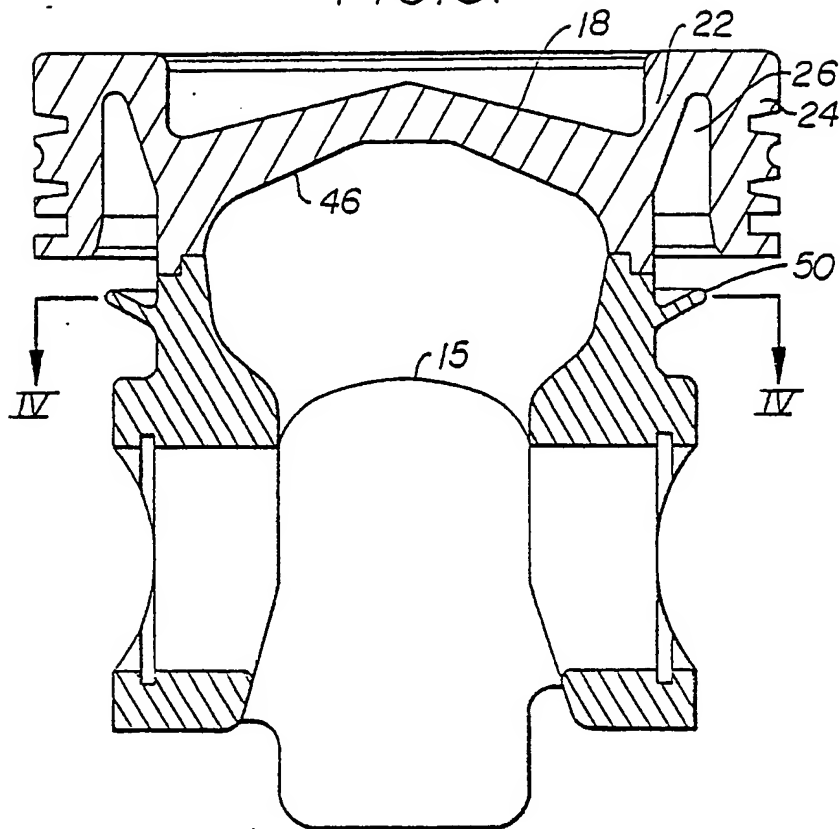
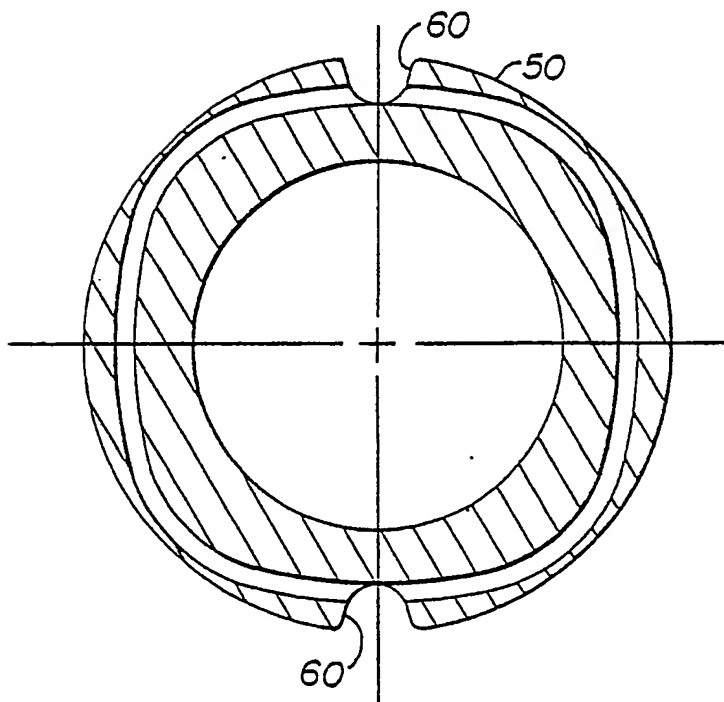


FIG. 4.



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FIG. 5.

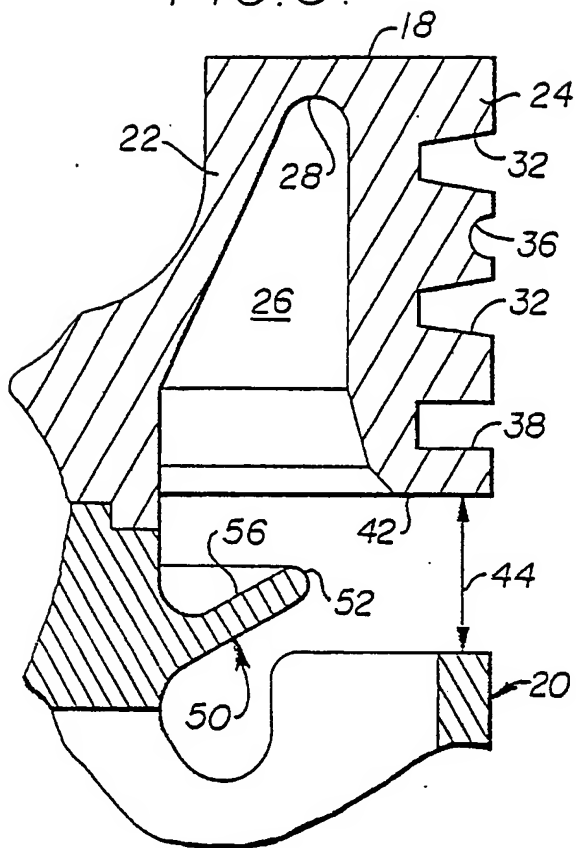


FIG. 6.

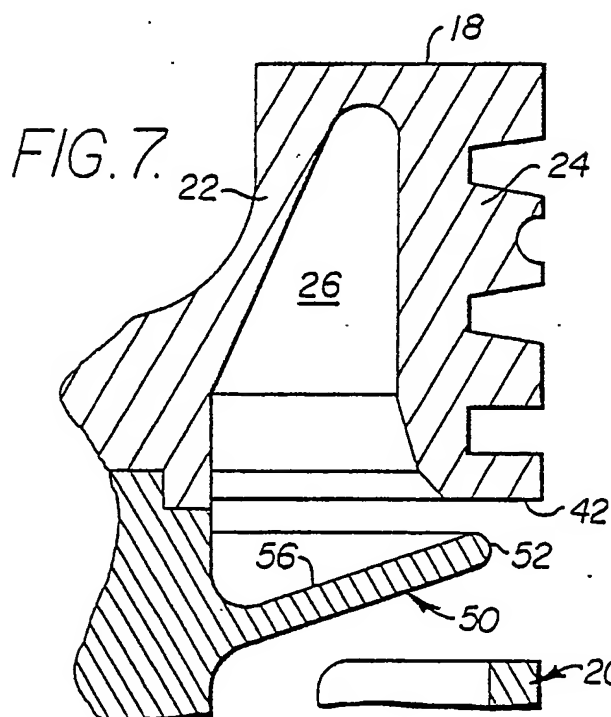
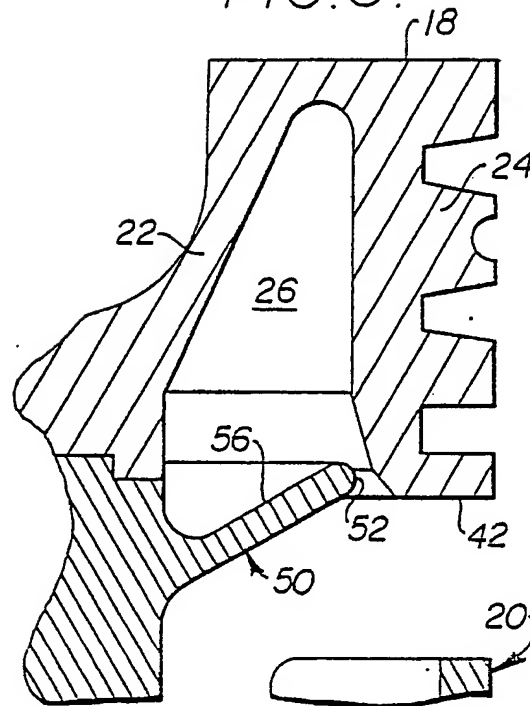


FIG. 8.

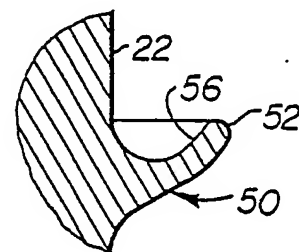


FIG. 9.

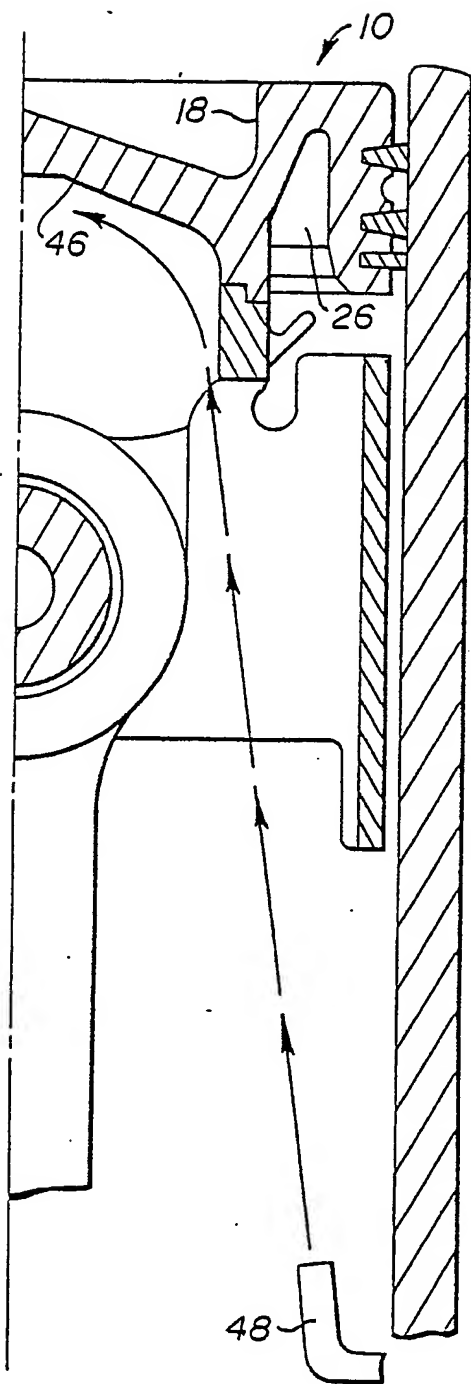
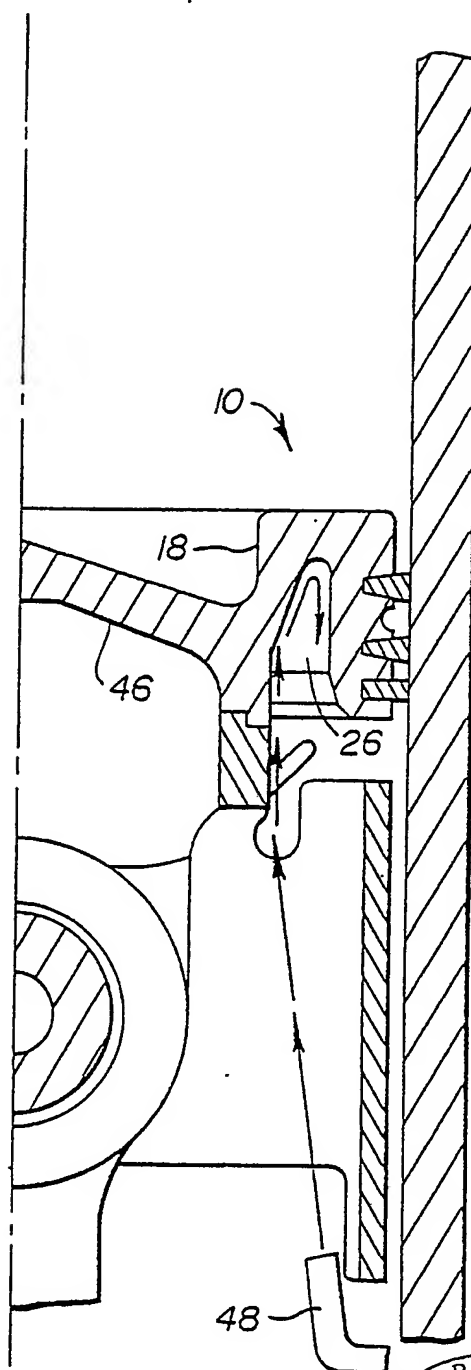


FIG. 10.



# INTERNATIONAL SEARCH REPORT

International Application No PCT/US79/00259

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>3</sup> According to International Patent Classification (IPC) or to both National Classification and IPC INTL. CL. F01P 3/06 U.S. CL. 92/186; 123/41.35						
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched <sup>4</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px; vertical-align: top;">U.S.</td> <td style="padding: 5px; vertical-align: top;">92/158, 159, 160, 186, 237, 238, 123/ 41.35</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>5</sup></div>			Classification System	Classification Symbols	U.S.	92/158, 159, 160, 186, 237, 238, 123/ 41.35
Classification System	Classification Symbols					
U.S.	92/158, 159, 160, 186, 237, 238, 123/ 41.35					
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>						
Category <sup>*</sup>	Citation of Document, <sup>16</sup> with Indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>				
A	US,A, 3,190,273 Published 22 June 1965 Bachle et al					
A	US,A, 3,336,844 Published 22 August 1967 Cornet					
A	US,A, 4,056,044 Published 1 November 1977 Kamman et al'	1, 3				
A	US,A, 4,129,108 Published 12 December 1978 Elsbett et al					
X <sub>1</sub> E	US,A, 4,175,502 Published 27 November 1979 Moebus	1, 3				
X	DE,A, 1,476,393 Published 24 April 1969	1-9				
A	GB,A, 617,224 Published 2 February 1949					
A	GB,A, 776,273 Published 5 June 1957					
<div style="font-size: small;"> <sup>*</sup> Special categories of cited documents: <sup>15</sup>            "A" document defining the general state of the art            "E" earlier document but published on or after the international filing date            "L" document cited for special reason other than those referred to in the other categories            "O" document referring to an oral disclosure, use, exhibition or other means            "P" document published prior to the international filing date but on or after the priority date claimed            "T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention            "X" document of particular relevance         </div>						
<b>IV. CERTIFICATION</b>						
Date of the Actual Completion of the International Search <sup>1</sup>  <div style="font-size: large; font-weight: bold;">08 JANUARY 1980</div>		Date of Mailing of this International Search Report <sup>2</sup>  <div style="font-size: large; font-weight: bold;">17 JAN 1980</div>				
International Searching Authority <sup>1</sup>  <div style="font-size: large; font-weight: bold;">ISA/US</div>		Signature of Authorized Officer <sup>20</sup>  <div style="font-size: large; font-weight: bold;">I.C. COHEN</div>				